WATER QUALITY MONITORING PROTOCOLS - REPORT NO. 6

PROTOCOLS FOR ASSESSMENT OF BIOTIC INTEGRITY (FISH) IN IDAHO STREAMS

Idaho Department of Health and Welfare

Division of Environmental Quality

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PROTOCOLS FOR ASSESSMENT OF BIOTIC INTEGRITY (FISH) IN IDAHO STREAMS

Prepared by:

Gwynne L. Chandler [1]

Terry R. Maret [2]

and

Don W. Zaroban

Idaho Department of Health and Welfare
Division of Environmental Quality
Monitoring and Technical Support Bureau
1410 N. Hilton
Boise, ID 83706-1253

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(1) Gwynne Chandler, Intermountain Research Station, 316 E. Myrtle, Boise, ID 83702
(2) Terry Maret, USGS, 230 Collins Rd., Boise, ID 83702

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INTRODUCTION

The Federal Clean Water Act and its amendments (Water Pollution Control Federation 1987) mandate Idaho Department of Health and Welfare, Division of Environmental Quality (DEQ) to gather data on the attainable biological communities in streams. This information can then be used as a "benchmark" for comparisons with other stream communities.

Biological integrity is defined as the "ability of a system to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region (Karr 1991)." Determining the biological integrity of a site requires gathering data from streams that have "minimum" human impacts (reference) as well as impacted streams from the various ecoregions and stream types in the state. This data must contain information on the aquatic biological community (fish, macroinvertebrates, etc.) and their environment, including community structure, community function, community condition, environmental tolerance, and habitat. It is essential the data be collected in concert using comparable, documented methodologies. This will ensure that data can be compared to reference conditions and trend information about sites can be detected.

In order to begin developing effective bioassessment tools and biocriteria for the various stream types in Idaho, it will be essential to characterize reference conditions which will be based, in part, on ecoregions (Omernik 1987). Data from "minimally impacted" sites made up of various habitat variables measured jointly with the biological (fish and macroinvertebrates) collections will provide insights on how biological potential relates to habitat quality. This process will require a long term commitment to monitor reference conditions and develop a database which can be used to provide the information necessary to develop mean expected conditions over a range of stream types. A key component of developing these metrics and scoring criteria is consistency in field protocols and data assessment. Standardization of methods is a fundamental prerequisite for any monitoring program. Without it, the utility of environmental monitoring data can, and will be challenged. This approach will also allow data to be compared between ecoregions and stream types to begin identifying similarities in community types. This will facilitate the development of regional expectations for development of biocriteria.

This protocol is one in a series intended to help provide consistency in water quality monitoring methods in Idaho resulting from the Final Agreement To Implement An Antidegradation Policy For The State Of Idaho, Executive Order No. 92-23 (Office of the Governor 1992), and the Coordinated Nonpoint Source Water Quality Monitoring Program For Idaho (Clark 1990). Other protocols in this series include "Protocols for Assessment of Dissolved Oxygen, Fine Sediment, and Salmonid Embryo Survival in an Artificial Redd" (Burton et al. 1990); "Estimating Intergravel Salmonid Living Space Using the Cobble Embeddedness Sampling Procedure" (Burton and Harvey 1990); "Monitoring Stream Substrates, Pool Volumes, and General Habitat Diversity" (Burton 1991a); "Protocols for Evaluation and Monitoring of Stream/Riparian Habitats Associated with Aquatic Communities in Rangeland Streams" (Burton 1991b); "Protocols for Assessment of Biotic Integrity (Macroinvertebrates) in Idaho Streams" (Clark and Maret 1993); "Protocols For Conducting Use Attainability Assessments For Determining Beneficial Uses To Be Designated On Idaho Stream Segments" (Maret and Jensen

1991); and, "Protocols For Classifying, Monitoring, And Evaluating Stream/Riparian Vegetation On Idaho Rangeland Streams" (Cowley 1992).

Monitoring the fish community is an important tool when assessing water quality. Plafkin et al. (1989) list many advantages of using fish in a biomonitoring program, some of which include:

1. Fish are relatively long-lived and mobile thus giving insight to trends over several years.
2. Fish communities generally represent a variety of trophic levels thus reflective of environmental health.
3. Fish are economically important from a food and recreation aspect.
4. Fish are relatively easy to collect and identify to the species level. This reduces the cost of a monitoring effort based on chemical analysis.
5. Beneficial uses are based on the fish community such as warm water biota, cold water biota, and salmonid spawning.
6. Chemical data is difficult for the public to understand while fishery information is more easily understood.

Trend information is one of the most important pieces of information that will come out of a monitoring program. Data collected consistently will help determine the health of a waterbody. This is essential when determining management practice effectiveness, and beneficial use support status, and long term trends in resource quality. A properly designed and implemented monitoring program is essential in determining watershed health.

The DEQ has defined three intensities of monitoring: basic or Level 1 monitoring, reconnaissance or Level 2 monitoring, and intensive or Level 3 monitoring (IDHW 1991). Basic monitoring is generally defined as an office compilation of existing data, information, assessments and reports. Reconnaissance monitoring refines and builds upon basic monitoring through qualitative field assessments or limited quantitative field assessments. Intensive monitoring builds on basic and reconnaissance monitoring through rigorous, documented, and reproduceable field measurements. More detailed explanations of monitoring intensity levels are contained in the methods section of this protocol.

At all field monitoring levels habitat assessment must be completed in conjunction with fish community assessment. The purpose and scope of the monitoring will dictate the level of effort required to assess habitat. Qualitative methods used to assess Idaho streams can be found in Platts, et al. (1983); Burton (1991a); Burton (1991b); and Cowley (1992).

METHODS

Basic Monitoring:

An exhaustive review of the literature, compilation of existing data, STORET information, and any other pertinent data will be used to estimate the condition of beneficial uses. A questionnaire (Figure 1) taken from Plafkin et al. (1989) can be used to help determine current status of the site. These forms should be sent to the regional fishery manager and/or other area fishery experts. All information collected at this level should be completed in-house with no field work involved. This is an essential step in defining data needs and identifying affected fish communities.

Reconnaissance:

This level of intensity is intended to provide an estimated condition through qualitative assessments or quantitative assessments limited in scope. Reconnaissance monitoring builds upon and refines the data and information obtained through basic monitoring. Reconnaissance monitoring is an inventory used for prioritizing stations for intensive monitoring and does not require a comparison to reference conditions. An on-site visit is required at this level of monitoring.

Collection time - July 1 - October 15 (during the low/stable flow period)

Methods - Ocular survey, snorkeling, seining, backpack or generator boat mounted electrofishing unit

Sample collection - Stream size will dictate the crew needed and particular method used for the census. If snorkeling is chosen, a multiple snorkeler team will be needed if one person, positioned in the center of the channel cannot see both banks adequately; if the snorkeling is to be done at night; or if water temperature is low enough (9° C) to reduce fish mobility. Snorkeling is the recommended procedure in waters known or suspected to contain fish species that are endangered, threatened, or "species of special concern". The Idaho Department of Fish and Game has compiled a list of fish species classified as threatened, endangered, or of special concern (Moseley and Groves 1992). Endangered fish species in Idaho include sockeye salmon (*Oncorhynchus nerka*), fall chinook salmon (*O. tshawytscha*), Kootenai River white sturgeon (*Acipenser transmontanus*) and Bonneville cutthroat trout (*O. clarki*). Threatened fish include summer and spring chinook salmon and burbot (*Lota lota*). Species of special concern include Snake River white sturgeon; some steelhead (*O. mykiss*) stocks; Idaho subspecies of redband trout (*O. m. gairdneri*) (Behnke 1992) and bull trout (*Salvelinus confluentus*)(Robins, et al. 1991); westslope, Yellowstone, Bear Lake, and finespotted cutthroat trout (*O. clarki* ssp.); Bear Lake (*Prosopium abyssicola*) and Bonneville (*P. spilonotus*) whitefish; Bonneville cisco (*P. gemmiferum*); leatherside chub (*Gila copei*); Bear Lake (*Cottus extensus*), Shoshone (*C. greenei*), and Wood River (*C. leiopomus*) sculpins; and sand roller (*Percopsis transmontana*).

If electrofishing is chosen, a generator boat mounted electrofisher may be required on larger streams. Choice of sampling gear is based upon best professional judgement of the crew chief. An aquatic biologist trained in the use of electrofishing equipment and identification of Idaho fish is required when conducting this level of monitoring. Ocular or walk through surveys of fish species present and/or redd counts are also acceptable at this level, but not encouraged. This data can be reported in the comments section on the backside of the impairment assessment sheet (Figure 2).

The sample site should be long enough to be representative of the stream reach and needs to include the major habitat types. The length sampled should be at least 20X mean width or a minimum of 100m. At a minimum, an impairment assessment form (Figure 2) and a habitat assessment data sheet (Figure 3 or 4) are filled out prior to any stream sampling (Plafkin et al. 1989). Burton (1991) outlines a qualitative ocular assessement of habitat (levels IIa/b) which is most appropriate at this level. Documentation of the sites using slides is also required at this level. A collecting permit and any federal Endangered Species Actmust be obtained from Idaho requirements need to be accounted for prior to any collections. One pass snorkeling or electrofishing methods are utilized to collect sufficient information on estimated condition. Blocknets should only be used if needed to collect a representative sample. Conductivity should be checked prior to electrofishing and recorded. If the conductivity is below 100 umhos the efficiency of the electrofishing maybe reduced and alternative collection methods such as snorkeling may be required. Handling stress can be minimized if the fish are anesthetized. Carbon dioxide, present in carbonated water or generated from solid tablets, serve as an effective fish anesthetic (Summerfelt and Smith 1990). Approximately 350 ml of carbonated water or two tablets containing CO_2 per 12 L of water will anesthetize fish after 2-5 minutes. The use of MS-222 is no longer highly recommended.

All fish are identified to the species level, determined to be young of the year (YOY), juveniles, or adults, and counted for relative abundance estimates (Figure 5). Note any external anomalies such as deformities, eroded fins, lesions, tumors, parasites or other unusual conditions of individual fish. In order to meet the requirements of STORET a confidence identification code must accompany the species counts. The four categories are as follows: A = 99.9% confident; B = 99% confident; C = 90% confident; and, D = percent confidence unknown.

The data collected will be relative abundances of the fish community present as well as young-of-year presence or absence. These data will be used to assess beneficial use status of the stream reach. A field equipment list is provided in Appendix A. Appendix B lists the fishes of Idaho along with their taxa, tolerance, trophic and origin codes. Taxanomic keys helpful in identification of fish species can be found in Simpson and Wallace (1982); Sigler and Sigler (1987); and Page and Burr (1991).

Intensive Monitoring:

This level of monitoring is intended to provide population information, density, and statistically valid results. These assessments will also determine the status of the beneficial uses and trends in biotic integrity. Station locations will generally be revisited annually over a long period (5-10 years) to assess trends and evaluate BMP effectiveness. This level of monitoring requires a comparison to a reference or expected attainable condition for similar stream types in the ecoregion or drainage. A comparison to a regionally expected condition for each metric is preferred but not mandatory. A comparison to only one upstream or paired reference station is acceptable, at least until other data become available.

Collection time - July 1 - October 15 (during the low/stable flow period)

Methods - snorkeling, backpack electrofishing, and/or generator boat mounted electrofishing unit (both using blocknets)

Sample collection - Selection of gear for sampling will be based upon best professional judgement as with reconnaissance monitoring. Again, this level requires the presence of a trained fisheries biologist and a collection permit obtained from Idaho Department of Fish and Game. Methodology will follow Rapid Bioassessment Procedure V (Plafkin et al. 1989).

If snorkeling is the method selected, the intensive monitoring should follow the methods of Northcote and Wilkie 1963; Schill and Griffith 1984; Hankin and Reeves 1988; Zubik and Fraley 1988; Thurow 1991; or Hillman, et al. 1992. The length sampled will be at least 20X the stream width or at least 100m. It is important that all availabe habitats are sampled within the reach.

If electrofishing is selected, the sites sampled should be representative of a stream reach and incorporate at least one of each of the habitat types indicative of that reach. Length sampled will be at least 20X the width or a minimum of 100m. Block nets are placed at both ends of the site sampled and are analyzed with each pass just as fish captured. Instream disturbances should be minimized in the sample reach to insure resident fish remain in the area to be sampled. Procedures used will be either mark-recapture techniques, removal methods, or an equivalent population estimation technique. All fish captured are recorded to the species level, key species (important game and/or fish species of concern) have their total length measured (mm) and weighed (g) individually. Note external anomalies of individual fish as stated above. Other species (nongame) are counted and composite weights taken. Uncertainty regarding identification may require specimens be preserved for later identification in the laboratory. A 10% buffered formalin solution is recommended for field preservation. Ethyl alcohol (70%) is recommended after field preservation for long term storage. A sample label for voucher specimens is provided in Figure 6. **It is important to note that fishery data to be collected in this monitoring scheme is a complete community assessment including <u>all</u> species (Figure 7).** Streams containing salmonids will be evaluated further to characterize age structure and biomass. Generally the removal method is more appropriate for small streams (1-3 order) while mark-recapture is more applicable to larger streams. The three pass removal is generally the minimum effort for estimating populations (Zippin 1956). Assessment of Salmonid fisheries may also require the separation of hatchery and native fish. Eroded and/or deformed fins, raceway abrasions and dull color pattern can usually be uksed to identify hatchery stock. If it is dtermined beneficial to obtain stocking records from regional Idaho Department of Fish and Game offices to assess the affects of this action on the observed fish community structure. The equipment needed for intense monitoring is the same as that required for reconnaissance electrofishing data collection (Appendix A) except this level requires block nets. Species codes are the same as those used in reconnaissance monitoring (Appendix B).

DATA ANALYSIS

Basic

Expected outcomes from basic monitoring are a literature review and summary of the questionnaire results. These items will give direction on the appropriate aquatic life beneficial use designation(s) for a particular stream segment or watershed and additional data needs.

Reconnaissance

Reconnaissance monitoring will provide qualitative as well as limited quantitative information. Metrics that can be used with these data include: species relative abundances, species richness, number of native species, number of introduced species, number of salmonid species, proportion of young of the year (YOY), and trophic composition (Table 1). These data combined with the habitat and macroinvertebrate information will better refine the aquatic life beneficial use designation(s) and give some insight into use attainability. Data collected with this level of monitoring cannot be analyzed statistically as there is no way of determing sampling bias or error.

Intensive Monitoring

Analysis should follow guidance provided for RBP V (Plafkin et al. 1989). Data obtained during intense monitoring is intended to be statistically summarized. Data collected with intense monitoring can be summarized using many metrics in the categories of: species richness and composition; trophic composition; abundance and density; and, condition and age structure (Table 1). The tolerance values and trophic guilds of Idaho fishes can be found in Appendix A. These values were obtained from the literature (Simpson and Wallace 1982, Sigler and Sigler 1987, and Ohio Environmental Protection Agency 1989).

Obtaining population estimates of all species can be done many ways. For small streams, Armour, et al. (1983) recommends the removal method where efficient electrofishing is possible and describes the population estimate calculations. If the removal method was used, MicroFish 3.0 (Van Deventer and Platts 1989) is a user friendly IBM based computer program that can be obtained from the American Fisheries Society Computer Users Section. Methodology for computing population estimates using mark-recapture or the removal method can also be found in Ricker (1975).

The summarized data will be scored following the theory of Plafkin et al. (1989). Each metric will be scored to reflect a comparison to appropriate regional reference site(s) or reference condition. Metric values approximating, deviating slightly from, or deviating greatly from values occurring at the reference sites are scored 5, 3, or 1, respectively. The scores of each metric are added for the station to give an overall Index of Biotic Integrity (IBI). Best professional judgement and input from regional fishery experts is involved in choosing the most appropriate population or community metric and in scoring criteria. Care needs to be taken when using metrics that are ratios between various attributes of the aquatic community as opposed to proportions between one attribute and the entire community. Statistically, metrics that are proportions tend to be less variable than metrics that are ratios. Similarly, measures of community structure, function, condition, and environmental tolerance are less variable than population and biomass estimates. Additional reference data as it becomes available will facilitate and validate the appropriate metrics to characterize biotic integrity. Fish data in concert with the habitat and macroinvertebrate components expressed as a percent of reference will determine the beneficial use support status of a given stream segment (Figure 8).

Table 1. List of fish metrics used when analyzing stream health. Those marked by an (*) are the recommended metrics to assess the biotic integrity of cold waters.

	Metric category Metric	Metric description
	SPECIES RICHNESS AND COMPOSITION	
	Total number of species	Total number of fish species in the sample. This metric will theoretically decrease with increasing degradation. Cold water fisheries may not exhibit an inverse relationship to degradation. Degradation such as thermal pollution may actually increase the number of species.
*	Number of native species	Total number of fish species native to Idaho in the sample. This metric should be higher in the minimum impacted sites.
	Number of introduced species	Total number of fish species introduced to Idaho in the sample. Introduced fish will generally do better than natives in degraded sites.
*	Number of salmonid species	Total number of Salmonidae in the sample. This metric will decrease as degradation occurs. Salmonidae will also provide information for the cold water biota use status.
*	Number of benthic insectivores	Total number of benthic insectivorous species in the sample. These species are bottom feeders and generally inhabit the interstices of substrate thus are indicators of siltation.
*	Number of intolerant species	Total number of intolerant species in the sample. Intolerant species are sensitive to change therefore theoretically this metric will decrease with increasing degradation.
	% Introduced species	Total number of introduced species in relation to the total number of species. As degradation occurs native species will drop out of the habitat and introduced species will invade.

Table 1. Continued

Metric category Metric	Metric description
* Jaccard Coefficient	Measures the degree of similarity in species composition between two stations in terms of species presence or absence. The formula is: Jaccard Coefficient = (a/(a+b+c)) where: a = number of species common to both samples; b = number of species present in B but not A; c = number of species present in A but not B; A = reference station (or mean of reference database); and, B = station of comparison.
TROPHIC COMPOSITION	
% Carnivores	Number of individual top carnivores in relation to the total number in the sample. As degradation increases the top carnivores generally drop out of the population.
% Omnivores	Number of omnivores in relation to the total number in the sample. These species feed on plant and animal material. Omnivores will increase in a population as the habitat deteriorates (Plafkin et al. 1989).
* Insectivores	Number of insectivores versus the total number in the sample. Degradation in a system will generally result in the exclusion of invertebrate species thus shifting the trophic guild from insectivorous to omnivorous.
ABUNDANCE AND DENSITY	
* % Salmonids	Proportion of the sample that is salmonids. This metric will decrease with increasing degradation.
Density (#/ha)	Total density in the habitat sampled. As habitat available is decreased this metric will decrease. This metric will often decrease in oligotrophic waters.

Table 1. Continued

Metric category Metric		Metric description
*	Total Fish Biomass (Kg/ha)	Total fish biomass in the habitat sampled. Theoretically this metric should also decrease as degradation increases. This metric will often decrease in oligotrophic waters.
	Salmonid density (#/ha)	Salmonid density in the habitat sampled. Again, as degradation increases, salmonid species will drop out of the habitat.
*	Salmonid biomass (Kg/ha)	Salmonid biomass in the habitat sampled.
	Fish per Unit of Effort (#/min.)	Fish captured per unit of time sampled. A relative measure of abundance using standartd colleciton techniques.
CONDITION AND AGE STRUCTURE		
	% YOY	Proportion of YOY or juveniles in the sample. This metric will provide information on recruitment into the population.
*	% YOY salmonids	Proportion of YOY or juvenile Salmonidae in the sample. This metric provides salmonid recruitment and salmonid spawning beneficial use information.
*	% Anomalies	Proportion of fish in the sample with external lesions, tumors, parasites and fin erosion, etc. As habitat quality decreases this metric will increase.
	Salmonid condition factor	Comparison of weight and length in an individual given by the formula $(w/l^3))*10,000$ where w = weight (in grams) and l = length (in mm). This index is useful for comparing the relative condition of individual fish of the same species between stations.

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FISH ASSEMBLAGE QUESTIONNAIRE

INTRODUCTION

This questionnaire is part of an effort to assess the biological health or integrity of the streams of this state. The focus of this questionnaire is on the biotic health of the designated waterbody as indicated by its fish community.

Using the scale below, please circle the rank (at left) corresponding to the explanation (at right) that best describes your impression of the condition of the waterbody. Please complete all statements. If you feel that you cannot complete the questionnaire, check here [ ] and return it. If you are unable to complete the questionnaire but are aware of someone who is familiar with the waterbody, please give this person's name address, and telephone number in the space below:

Name:______________________________
Address:______________________________
____

Phone:( )______________________________

Stream Name:____________________ Section:__________
Site Description:______________________________
____

Drainage:____________________ Ecoregion: __________

STORET Code:______________________________
Longitude:_______________ Latitude: _______________
Township:__________ Range:__________ Section:__________
Stream Order:______________________________

Figure 1. Fish Assemblage Questionnaire from Plafkin et al. 1989.

Please answer questions 1-4 using this scale:

5 Species composition, age classes, and trophic structure comparable to minimum impacted sites of similar size in that ecoregion.

4 Species richness somewhat reduced by loss of some intolerant species; YOY of top carnivores rare; less than optimal abundances, age distributions, and trophic structure for size and ecoregion.

3 Intolerant species absent, considerably fewer species and individuals than expected for that waterbody size and ecoregion, older age classes of top carnivores rare, trophic structure skewed toward omnivory.

2 Dominated by highly tolerant species, omnivores, and habitat generalists; top carnivores rare or absent; older age classes of all but tolerant species rare; diseased fish and anomalies relatively common for that waterbody size and ecoregion.

1 Few individuals and species present, mostly tolerant species and small individuals, diseased fish and anomalies abundant compared to other similar-sized waterbodies in the ecoregion.

0 No fish

(Circle one number using the scale above)

1. Rank the current conditions of the reach
   5 4 3 2 1 0

2. Rank the condition of the reach 10 years ago
   5 4 3 2 1 0

3. Given present trends, how will the reach rank 10 years from now ?
   5 4 3 2 1 0

4. If the major human-caused limiting factors were eliminated, how would the reach rank 10 years from now ?
   5 4 3 2 1 0

Figure 1. Continued

(Please complete each subsection by circling the single most appropriate limiting facotr and probable cause.)

Subsection 1 -- Water Quality

Limiting Factor	Probable Cause
Temperature too high	Primarily upstream
Temperature too low	Within reach
Turbidity	Point source discharge
Dissolved Oxygen	Industrial
Gas supersaturation	Municipal
pH too acidic	Combined sewer
pH too basic	Mining
Nutrient deficiency	Dam release
Nutrient surplus	Nonpoint source discharge
Toxic substances	Individual sewage
Heavy Metals	Urban runoff
Other: ______________________	Landfill leachate
	Construction
Not limiting ______________________	Irrigation return
	Feedlot
	Grazing
	Silviculture
	Mining
	Natural
	Unknown
	Other: ______________________

Subsection 2 -- Water Quality

Limiting Factor	Probable Source
Below optimum flows	Dam
Above optimum flows	Diversion
Loss of flushing flows	Watershed conversion
Excessive flow fluctuations	Agriculture
Other:	Silviculture
	Grazing
Not limiting	Urbanization
	Mining
	Natural
	Unknown
	Other: ______________________

Figure 1. Continued

Subsection 3 -- Habitat Structure

Limiting Factor	Probable Cause
Excessive siltation	Agriculture
Insufficient pools	Silviculture
Insufficient riffles	Mining
Insufficient instream cover	Grazing
Insufficient instream cover	Dam
Insufficient bank cover	Diversion
Poor bank stability	Channelization
Insufficient riparian zone	Other channel modifications
Insufficientreproductive habitat	Natural
Other: ____________	Unknown
	Other: ____________
Non limiting	

Subsection 4 -- Fish Community

Limiting Factor	Probable Source
Overharvest	Anglers
Underharvest	State agencies
Introductions	Federal agencies
Fish stocking	Point source
Migration barrier	Nonpoint source
Hybridization	Natural
Other: ____________	Unknown
	Other:
Not limiting ____________	

Subsection 5 -- Major Limiting Factor

Water Quality
Water Quantity
Habitat Structure
Fish Community
Other: ____________

Your Name Please: ____________

Figure 1. Continued

Any references known:

Figure 1. Continued

IMPAIRMENT ASSESSMENT SHEET

1. Detection of impairment:
   Impairment detected . . . . (Complete items 2-6)
   No impairment detected . . . . (Stop here)

2. Biological impairment indicator:

	Fish		**Other aquatic communities**
______	Intolerant species reduced/absent	______	Macroinvertebrates
______	Dominance of tolerant species	______	Periphyton
______	Skewed trophic structure	______	Macrophytes
______	Hybrid or exotic abundance usually high		
______	Poor size class representation		
______	High incidence of anomalies		

3. Brief description of problems: ______________________________

   Year and date of previous surveys: ______________________________

   Survey data available in: ______________________________

4. Cause: (Indicate major cause)

______	organic enrichment	______	flow
______	poor habitat	______	temperature
______	toxicants	other: ______________	

5. Estimated extent of problem (m^2) applicable: ______________________________

   Length of stream reach affected (m) where applicable: ______________________________

6. ______________________________

   Suspected source (s) of problem:

______	Point source	______	Landfill
______	Urban runoff	______	Mine
______	Agricultural runoff	______	Dam
______	Silvicultural	______	Diversion
______	Livestock	______	Channelization
______	Landfill	______	Natural
		______	Unknown

   Other: ______________________________

Figure 2. Impairment assessment sheet (Plafkin et al. 1989).

COMMENTS

Figure 2. Continued.

Stream Name: ______________ Station: ______________ Date: ______________ Location Description: ______________

Idaho Department of Health and Welfare - Division of Environmental Quality
HABITAT ASSESSMENT FIELD DATA SHEET
RIFFLE/RUN PREVALENCE

	CATEGORY			
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1. Bottom substrate/ instream cover	Greater than 50% mix of rubble, gravel, submerged logs undercut banks, or other stable habitat. 16-20 ___	30-50% mix of rubble, gravel, or other stable habitat. Adequate habitat. 11-15 ___	10-30% mix of rubble, gravel, or other stable habitat. Habitat availability less than desirable. 6-10 ___	Less than 10% rubble, gravel or other stable habitat. Lack of habitat. is obvious. 0-5 ___
2. Embeddedness	Gravel, cobble and boulder particles are between 0-25% surrounded by fine sediment. 16-20 ___	Gravel, cobble and boulder particles are between 25-50% surrounded by fine sediment. 11-15 ___	Gravel, cobble and boulder particles are between 50-75% surrounded by fine sediment. 6-10 ___	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment. 0-5 ___
3. 0.15 cms (5 cfs) at rep. low flow	Cold > 0.05 cms (2 cfs), Warm > 0.15 cms (5 cfs) 16-20 ___	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15 ___	0.01-0.03 cms (0.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10 ___	< 0.01 cms(0.5 cfs) < 0.3 cms (1 cfs) 0-5 ___
OR >0.15 cms (5 cfs) velocity/ depths	Slow (< 0.3 m/s), deep (> 0.5 m): slow, shallow (< 0.5 m): fast (> 0.3 m/s), deep; fast, shallow habitats all present. 16-20 ___	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools. 11-15 ___	Only 2 of the 4 habitat categories present (missing riffles or runs receive lower score) 6-10 ___	Dominated by 1 velocity/depth category (usually pools) 0-5 ___

Figure 3. Riffle/Run Habitat assessment form (EA Engineering, Science & Technology Inc. 1991).

RIFFLE/RUN PREVALENCE
PAGE 2

	CATEGORY			
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
4. Canopy cover (shading)	A mixture of conditions where some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light. 16-20 ___	Covered by sparse canopy; entire water surface receiving filtered light. 11-15 ___	Completely covered by dense canopy; water surface completely shaded or nearly full sunlight reaching water surface. Shading limited to < 3 hours per day. 6-10 ___	Lack of canopy, full sunlight reaching water surface. 0-5 ___
5. Channel alteration	Little or no enlargement of islands or point bars, and/or no channelization. 12-15 ___	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization. 6-11 ___	Moderate deposition of new gravel, coarse sand no old and new bars; and/or embankments on both banks. 4-7 ___	Heavy deposits of fine material, increased bar development; and/or extensive channelization. 0-3 ___
6. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and/or deposition. 12-15 ___	5-30% Affected. Scour at constrictions and where grades steepen. Some channelization. 8-11 ___	Moderate deposition of new gravel, coarse sand no old and new bars; and/or embankments on both banks. 4-7 ___	Heavy deposits of fine material, increased bar development; and/or extensive channelization. 0-3 ___

Figure 3. Continued.

CATEGORY				
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
7. Pool/riffle run /bed ratio (distance between riffles divided by stream width).	Ratio: 5-7 Variety of habitat. Repeat pattern of sequence relatively frequent. 12-15 ___	7-15 Infrequent repeat pattern. Variety of macrohabitat less than optimal. 8-11 ___	15-25 Occasional riffle or bend. Bottom contours provide some habitat. 4-7 ___	Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3 ___
8. Lower bank channel capacity	Overbank (lower flows rare. Lower bank W/D ratio 7. (Channel width divided by depth or height of lower bank.) 12-15 ___	Overbank (lower) flows occasional. W/D ratio: 8-15. 8-11 ___	Overbank (lower) flows occasional. W/D ratio: 15-25 4-7 ___	Peak flows not contained or contained through channelization. W/D ratio >25 0-3 ___
9. Upper bank stability	Upperbank stable. No evidence of erosion or bank failure. Side slopes generally < 30°. Little potential for future problems. 9-10 ___	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40° on one bank. Slight potential in extreme floods. 6-8 ___	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60° on some banks. High erosion potential during extreme high flow. 3-5 ___	Unstable. Many eroded areas. "Raw" areas frequent along straight sections and bends. Side slopes > 60° common. 0-2 ___

Figure 3. Continued.

RIFFLE/RUN PREVALENCE
PAGE 4

CATEGORY				
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
10. Bank vegetation protection OR Grazing or other disruptive pressure	Over 90% of the streambank surfaces covered by vegetation. 9-10 ___ Vegetative disruption minimal or not evident. Almost all potential plan biomass at present stage of development remains. 9-10 ___	70-89% of the stream bank surfaces covered by vegetation. 6-8 ___ Disruption evident but not affecting community vigor. Vegetative use is moderate, and at the potential plant biomass remains. 6-8 ___	50-79% of the stream bank surfaces covered by vegetation. 3-5 ___ Disruption obvious; some patches of bare soil or closely cropped vegetation present. Less than one half of the potential plant biomass remains. 3-5 ___	Less than 50% of the streambank surfaces covered by vegetation. 0-2 ___ Disruption of stream bank vegetation is very high. Vegetation has been removed to 2 inches or less in average stubble height. 0-2 ___
11. Streamside cover	Dominant vegetation is shrub. 9-10 ___	Dominant vegetation is of tree form. 6-8 ___	Dominant vegetation is grass or forbes. 3-5 ___	Over 50% of the stream bank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2 ___
12. Riparian vegetative zone width (least buffered side)	> 18 meters 9-10 ___	Between 12 and 18 meters. 6-8 ___	Between 6 and 12 meters. 3-5 ___	< 6 meters. 0-2 ___
Column Totals:	___	___	___	___
SCORE				

Figure 3. Continued.

Stream Name: ____________ Station: ____________ Date: ____________ Location Description: ____________

IDAHO DEPARTMENT OF HEALTH AND WELFARE HABITAT ASSESSMENT FIELD DATA SHEET GLIDE/POOL PREVALENCE				
	CATEGORY			
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1. Bottom substrate/ instream cover	Greater than 50% mix of rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20 ___	30-50% mix of rubble, gravel, or other stable habitat. Adequate habitat. 11-15 ___	10-30% mix of rubble, gravel, or other stable habitat. Habitat availability less than desirable. 6-10 ___	Less than 10% rubble, gravel or other stable habitat. Lack of habitat is obvious. 0-5 ___
2. Pool substrate characterization	Mixture of substrate materials with gravel and firm sand prevalent, root mats and submerged vegetation common. 16-20 ___	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present. 11-15 ___	All mud or clay or channelized with sand bottom; little or no root mat; no submerged vegetation. 6-10 ___	Hard-pan clay or bedrock; no root mat or vegetation. 0-5 ___
3. Pool variability	Even mix of deep/ shallow/ large/small pools present. 16-20 ___	Majority of pools large and deep; very few shallow. 11-15 ___	Shallow pools much more prevalent than deep pools. 6-10 ___	Majority of pools small and shallow or pools absent. 0-5 ___
4. Canopy cover (shading)	A mixture of conditions where some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light. 16-20 ___	Covered by sparse canopy; entire water surface receiving filtered light. 11-15 ___	Completely covered by dense canopy, water surface completely shaded; OR nearly full sunlight reaching water surface. Shading limited to < 3 hours per day. 6-10 ___	Lack of canopy, full sunlight reaching water surface. 0-5 ___

Figure 4. Glide/Pool Habitat Assessment Form (EA Engineering, Science & Technology Inc. 1991)

GLIDE/POOL PREVALENCE
PAGE 2

CATEGORY				
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
5. Channel alteration	Little or no enlargement of islands or point pars, and/or no channelization. 12-15 ___	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11 ___	Moderate deposition of new gravel, coarse sand on old and new bars; and/or embankments on both banks. 6-10 ___	Heavy deposits of fine material, increased bar development; and/or extensive channelization. 0-3 ___
6. Deposition	Less than 5 % of bottom affected; minor accumulation of coarse sand and pebbles as snags and submerged vegetation. 12-15 ___	5-30% affected; moderate accumulation of sand at snags and submerged vegetation. 8-11 ___	30-50% affected; major deposition of sand at snags and submerged vegetation; pools shallow, heavily silted. 4-7 ___	Channelized; mud, silt and/or sand in braided or non-braided channels; pools almost absent due to deposition. 0-3 ___
7. Channel sinuosity	Instream channel length 3 to 4 times straight line distance. 12-15 ___	Instream channel length 2 to 3 times straight line distance. 8-11 ___	Instream channel length 1 to 2 times straight line distance. 4-7 ___	Channel straight; channelized waterway. 0-3 ___
8. Lower bank channel capacity	Overbank (lower) flows rare. Lower bank W/D ratio < 7. (Channel width divided by depth or height of lower bank.) 12-15 ___	Overbank (lower) flows occasional. W/D ratio: 8-15 8-11 ___	Overbank (lower) flows occasional. W/D ratio: 15-25 4-7 ___	Peak flows not contained or contained through channelization. W/D ratio > 25 0-3 ___

Figure 4. Continued.

GLIDE/POOL PREVALENCE
PAGE 3

	CATEGORY			
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
9. Upper bank stability	Upper bank stable, No evidence of erosion or bank failures. Side slopes generally < 30°. Little potential for future problems. 9-10 ___	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40° on one bank. Slight potential in extreme floods. 6-8 ___	Moderately stable. Moderate frequency and size of erosional areas. Side slopes up to 60° on some banks. High erosion potential during extreme high flow. 3-5 ___	Unstable. Many eroded areas. "Raw" areas frequent along straight sections and bends. Side slopes 60° common. 0-2 ___
10. Bank vegetation protection	Over 90% of the streambank surfaces covered by vegetation. 9-10 ___	70-89% of the streambank surfaces covered by vegetation. 6-8 ___	50-79% of the streambank surfaces covered by vegetation. 3-5 ___	Less than 50% of the streambank surfaces covered by vegetation. 0-2 ___
OR				
Grazing or other disruptive pressure	Vegetative disruption minimal or not evident. Almost all potential plant biomass at present stage of development remains. 9-10 ___	Disruption evident but not affecting community vigor. Vegetative use is moderate, and at least one-half of the potential plant biomass remains. 6-8 ___	Disruption obvious; some patches of bare soil or closely cropped vegetation present. Less than one half of the potential plant biomass remains. 3-5 ___	Disruption of streambank vegetation is very high. Vegetation has been removed to 2 inches or less in average stubble height. 0-2 ___

Figure 4. Continued.

GLIDE/POOL PREVALENCE
PAGE 4

CATEGORY				
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
11. Streamside cover	Dominant vegetation is shrub. 9-10 ____	Dominant vegetation is of tree form. 6-8 ____	Dominant vegetation is grass or forbes. 3-5 ____	Over 50% of the stream bank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2 ____
12. Riparian vegetative zone width (least buffered side)	> 18 meters 9-10 ____	Between 12 and 18 meters. 6-8 ____	Between 6 and 12 meters. 3-5 ____	< 6 meters. 0-2 ____
Column Totals	____	____	____	____
Score				

Figure 4. Continued.

State of Idaho
Department of Health and Welfare
FISH COLLECTION DATA FORM (RECONNAISSANCE)

Name of Water Body:	Station Number:		STORET Code:	
	Reference Site (Y/N):			
Location Description:	Township:	Range:	Section:	Quarter:
Date of Collection (YYMMDD):	Time of Collection (military):		Collector(s):	
Flow Conditions:	Weather Conditions:			
Water Temp.:	Conductivity:		Water Clarity:	

Collection Method:	
	Habitat Sampled (%):
	Pools:
	Runs:
	Riffles:
	Pocketwaters:

Comments:

Figure 5. Data form for reconnaissance monitoring.

Name of Water Body:	Station Number:	Date of Collection (YYMMDD):

Fish Collection Record

Species Code	Species	Number of Adults	Number of Juveniles	Total Number	ID Conf.	Comments

Figure 5. Continued.

IDHW-DEQ FISH SAMPLE

Location______________________________
Storet______________________________
Sample Station________________________
Description__________________________

____

Legal_______________________________

County__________Elev________________

Date____________Time________________

Collector____________________________

AC ( ) Seine ( ) Snorkel ( )
DC ( ) Gill Net ( )

Figure 6. Example field sample label.

State of Idaho
Division of Environmental Quality
FISH COLLECTION DATA FORM (INTENSIVE)

Name of Water Body:	Station Number:		STORET Code:	
	Reference Site (Y/N):			
Location Description:	Township:	Range:	Section:	Quarter:
Date of Collection (YYMMDD)	Time of Collection (military):		Collector(s):	
Flow Conditions:	Weather Conditions:			
Water Temp.:	Conductivity:		Water Clarity:	

Collection Method:	Beginning Time:	Ending Time:

Number of Passes:	Habitat Sampled (%):
Effort (minutes):	Pools:
Site lengths (m):	Runs:
Site widths (m): (≥10)	Riffles:
	Pocket waters:

Comments:

Figure 7. Data form for intensive monitoring.

Name of Water Body:	Station Number:	Date of Collection (YYMMDD):

Fish Collection Record

Pass No.	Species Code	Species	Length (mm)	Weight (g)	Number	Anomalies	ID Conf.	Comments

Figure 6. Continued.

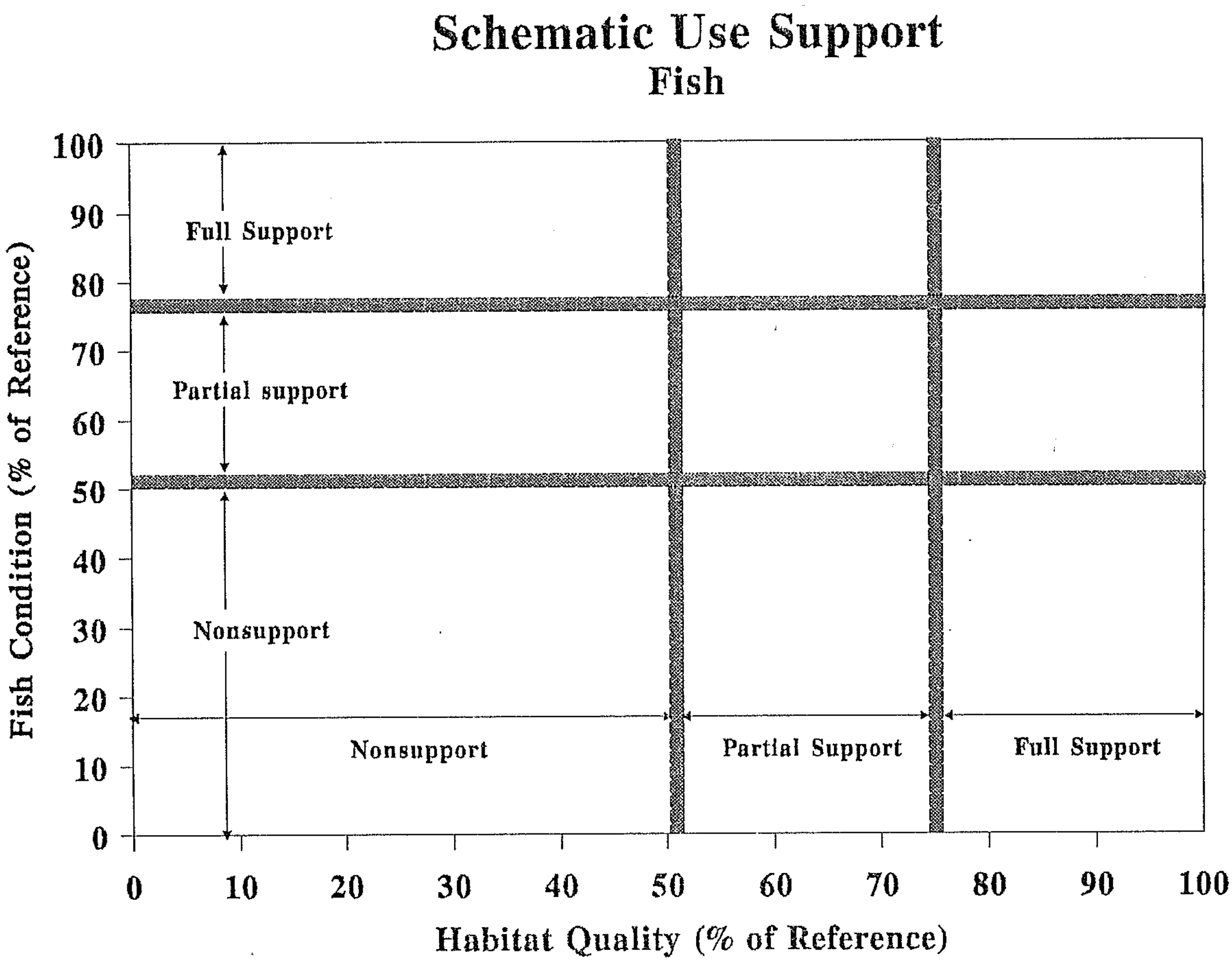

Figure 8. Fish use support schematic.

APPENDIX A

Appendix A. Equipment required for reconnaissance and intense monitoring (fish).

EQUIPMENT LIST

Snorkeling:

- ______ Hood
- ______ Gloves
- ______ Boots
- ______ Suit
- ______ Mask
- ______ Snorkel
- ______ Clipboard
- ______ Notebook
- ______ Pencils/Pens
- ______ Field data sheets
- ______ Thermometer
- ______ Length reference stick
- ______ Camera
- ______ CPR Certification

Electrofishing:

- ______ Shocker w/ electrodes
- ______ Dip nets
- ______ Block nets (not required for reconnaissance monitoring)
- ______ Waders
- ______ Rubber gloves, shoulder length
- ______ Buckets
- ______ Conductivity meter
- ______ Preservative (formalin) w/ jars
- ______ Weight/length scales
- ______ Fish keys
- ______ Thermometer
- ______ Collecting permit or IFG personnel
- ______ Carbonated soda or alka-seltzer tablets
- ______ Camera
- ______ Field data sheets
- ______ Gas/oil
- ______ Scale paper/envelopes/pocket knife (optional)
- ______ Clipboard/notebook/labels
- ______ First-aid kit
- ______ CPR Certification

APPENDIX B

Appendix B. List of Fishes of Idaho from Simpson and Wallace, 1982.

IDHW-DEQ FISH LIST

TAXA CODE	COMMON NAME	SCIENTIFIC NAME	TAXON LEVEL	FAMILY	T/C	TGR	ORIGIN
3	AMERICAN SHAD	*Alosa sapidissima*	GENSPE	CLUPEIDAE	MI	F	I
20	ARCTIC CHAR	*Salvelinus alpinus*	GENSPE	SALMONIDAE	II	I	I
24	ARCTIC GRAYLING	*Thymallus arcticus*	GENSPE	SALMONIDAE	II	I	I
18	ATLANTIC SALMON	*Salmo salar*	GENSPE	SALMONIDAE	II	I	I
71	BEAR LAKE SCULPIN	*Cottus extensus*	GENSPE	COTTIDAE	MI	V	N
12	BEAR LAKE WHITEFISH	*Prosopium abyssicola*	GENSPE	SALMONIDA	MI	V	N
48	BLACK BULLHEAD	*Ictaluras melas*	GENSPE	IDTALURIDAE	MT	I	I
64	BLACK CRAPPIE	*Pomoxis nigromaculatus*	GENSPE	CENTRARCHIDAE	MT	O	I
60	BLUEGILL	*Lepomis macrochirus*	GENSPE	CENTRARCHIDAE	MT	I	I
45	BLUEHEAD SUCKER	*Catostomus discobolus*	GENSPE	CATOSTOMIDAE	MT	I	N
14	BONNEVELLE CISCO	*Prosopium gemmiferum*	GENSPE	SALMONIDAE	MT	V	N
15	BONNEVILLE WHITEFISH	*Prosopium spilonotus*	GENSPE	SALMONIDAE	MT	I	N
44	BRIDGELIP SUCKER	*Catostomus columbianus*	GENSPE	CATOSTOMIDAE	TT	H	N
21	BROOK TROUT	*Salvelinus fontinalis*	GENSPE	SALMONIDAE	MI	I	I
49	BROWN BULLHEAD	*Ictalurus nebulosus*	GENSPE	ICTALURIDAE	TT	I	I
19	BROWN TROUT	*Salmo trutta*	GENSPE	SALMONIDAE	MI	C	I
22	BULL TROUT	*Salvelinus confluentus*	GENSPE	SALMONIDAE	II	I	N
54	BURBOT	*Lota lota*	GENSPE	GADIDAE	MT	P	N
30	CARP	*Cyprinus carpio*	GENSPE	CYPRINIDAE	TT	O	I
50	CHANNEL CATFISH	*Ictalurus punctatus*	GENSPE	ICTALURIDAE	MT	G	I
9	CHINOOK SALMON	*Oncorhynchus tshawytscha*	GENSPE	SALMONIDAE	II	I	N
27	CHISELMOUTH	*Acrocheilus alutaceus*	GENSPE	CYPRINIDAE	TT	O	N
5	CHUM SALMON	*Oncorhynchus keta*	GENSPE	SALMONIDAE	II	I	I
6	COHO SALMON	*Oncorhynchus kisutch*	GENSPE	SALMONIDAE	II	I	N
11	CUTTHROAT TROUT	*Oncorhynchus clarki*	GENSPE	SALMONIDAE	II	I	N
35	FATHEAD MINNOW	*Pimephales promelas*	GENSPE	CYPRINIDAE	TT	O	I
52	FLATHEAD CATFISH	*Pylodictis olivaris*	GENSPE	ICTALURIDAE	MT	P	I
17	GOLDEN TROUT	*Salmo aguabonita*	GENSPE	SALMONIDAE	II	I	I

T/C Tolerance to organic sediment and thermal pollution: (Ohio Environmental Protection Agency, 1989; Sigler and Sigler. 1987; and, Simpson and Wallace, 1982)

TGR Trophic Guild References (Ohio Environmental Protection Agency, 1989, Sigler and Sigler, 1987; and, Simpson and Wallace, 1982)

ORIGIN N = Native I = Introduced

Appendix B. Continued.

TAXA CODE	COMMON NAME	SCIENTIFIC NAME	TAXON LEVEL	FAMILY	T/C	TGR	ORIGIN
61	SMALLMOUTH BASS	*Micropterus dolomieui*	GENSPE	CENTRARCHIDAE	MI	C	I
7	SOCKEYE SALMON	*Oncorhynchus nerka*	GENSPE	SALMONIDAE	II	V	N
39	SPECKLED DACE	*Rhinichthys osculus*	GENSPE	CYPRINIDAE	MI	I	N
51	TADPOLE MADTOM	*Noturus gyrinus*	GENSPE	ICTALURIDAE	MT	I	I
41	TENCH	*Tinca tinca*	GENSPE	CYPRINIDAE	TT	V	I
74	TORRENT SCULPIN	*Cottus rhotheus*	GENSPE	COTTIDAE	II	I	N
32	TUI CHUB	*Gila bicolor*	GENSPE	CYPRINIDAE	TT	O	I
31	UTAH CHUB	*Gila atraria*	GENSPE	CYPRINIDAE	TT	O	N
42	UTAH SUCKER	*Catostomus ardens*	GENSPE	CATOSTOMIDAE	TT	O	N
66	WALLEYE	*Stizostedion vitreum*	GENSPE	PERCIDAE	MT	P	I
59	WARMOUTH	*Lepomis gulosus*	genspe	CENTRARCHIDAE	MT	C	I
63	WHITE CRAPPIE	*Pomoxis annularis*	GENSPE	CENTRARCHIDAE	MT	O	I
2	WHITE STURGEON	*Acipenser transmontanus*	GENSPE	ACIPENSERIDAE	II	G	N
73	WOOD RIVER SCULPIN	*Cottus leiopomus*	GENSPE	COTTIDAE	II	I	N
65	YELLOW PERCH	*Perca flavescens*	GENSPE	PERCIDAE	MI	C	I

TOLERANCE VALUE CODES

II = Highly intolerant
MI = Moderately intolerant
MT = Moderately tolerant
TT = High tolerant

TROPHIC GUILD CODES

A = Parasite
C = Carnivore
F = Filter feeder
G = Generalist
H = Herbivore
I = Insectivore
O = Omnivore
P = Piscivore
V = Invertivore

T/C Tolerance to organic sediment and thermal pollution: (Ohio Environmental Protection Agency, 1989; Sigler and Sigler. 1987; and, Simpson and Wallace, 1982)

TGR Trophic Guild References (Ohio Environmental Protection Agency, 1989, Sigler and Sigler, 1987; and, Simpson and Wallace, 1982)

ORIGIN N = Native I = Introduced

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